

THE BAKING QUALITY OF WHEAT IN ISRAEL ¹

M. PLAUT AND B. ZELZBUCH

Until 1940 only Durum wheat varieties were grown in Israel, but during the past 15 years varieties of Common wheat have been introduced by the Agricultural Experiment Stations, and now account for about half the wheat acreage.

It was desirable, therefore, to determine the comparative baking quality of flour made from locally-grown Common and Durum wheat varieties. This paper reports the results of an investigation carried out during 1950-52 in which five varieties of Durum wheats and three of Common wheats were tested for baking suitability.

Samples of the following varieties were taken from various locations in Israel:

Durum: Juljuli, Nursi, Heity, Mughrabi, Giza-4

Common: C.C.C., B.I.P.M., Morocco-386.

EXPERIMENTS AND RESULTS

PROTEIN AND ASH CONTENT.

Percentages of protein and ash were tested by A.O.A.C. methods (2).

Table 1 compares the moisture, protein, and ash content in 3 varieties each of Common and Durum wheats.

TABLE 1. — MOISTURE, PROTEIN, AND ASH CONTENT IN VARIETIES OF COMMON AND DURUM WHEATS

Variety	Moisture	Protein	Ash
Durum Wheat varieties:			
Nursi	11.7	11.6	1.85
Heity	11.8	12.3	1.97
Juljuli	11.9	12.0	1.84
Common varieties:			
C.C.C.	12.4	11.7	1.84
Morocco—386	12.1	10.9	1.62
B.I.P.M.	12.3	11.1	1.62

The data show that varieties of Common Wheat contain less ash but do not contain more protein than those of Durum Wheat.

The wheat proteins were separated by Osborne's method. Results presented in Table 2 show that the proportions of different proteins do not differ in Durum and Common Wheats.

¹ Agricultural Research Station, Rehovot, 1953 Series No. 30.

CLASSES OF PROTEIN.

TABLE 2. — PROTEIN CLASSES IN DURUM AND COMMON WHEAT VARIETIES
(% total protein)

Variety	Albumin	Globulin	Gliadin	Glutenin
Nursi	16.2	19.0	29.2	35.8
Heity	15.4	17.8	33.0	33.7
C.C.C.	14.4	15.0	32.5	38.1
Morocco—386	18.0	18.3	28.7	35.0

GAS-HOLDING ABILITY

Gas-holding ability was measured by means of the fermentation test originated by Pelshenke (10). Dough made from poor quality flour will lose gas and crumble after about 20 minutes of fermentation under controlled conditions, while dough made of good quality flour will hold together for 60 minutes or more.

Averaged results given below show that Common Wheat varieties have greater gas-holding ability than Durum Wheat varieties.

AVERAGE GAS-HOLDING ABILITY IN COMMON AND DURUM WHEAT VARIETIES

	Nursi	Heity	Juljuli	C.C.C.	B.I.P.M.	Morocco-386
Fermentation time (min.)	23	25	27	93	63	69

GLUTEN CONTENT AND QUALITY

The gluten, which forms a viscous network in the dough, is an important factor in determining baking properties. The moist gluten content was determined by A.O.A.C. method (2). Gluten quality was estimated by Krtynski's method (8) and was also determined by Berliner and Koopman's method (4,9) in which the volume of 1 g. of moist gluten is measured after swelling for 2½ hours in dilute lactic acid.

TABLE 3. — GLUTEN CONTENT AND QUALITY IN COMMON AND DURUM WHEAT VARIETIES

Variety	Moist Gluten %	Gluten Quality	Gluten colour	Results of Berliner's test (in ccm)
Juljuli	21.6	very bad	greenish-grey	0.4
Nursi	19.3	bad	greenish-yellow	0.2
Heity	23.5	medium-bad	yellow	0.3
Mughrabi	21.0	very bad	green	—
Giza—4	22.6	medium-bad	brown	0.5
C.C.C.	28.0	good	white	1.9
B.I.P.M.	24.2	medium	white	1.1
Morocco—386	25.1	good	yellowish-white	1.5

Data in Table 3 show that Common Wheat varieties had a higher percentage of gluten than the Durum Wheats and that in the latter gluten was very poor, being sticky, easily stretched but inelastic, and sometimes smearable. Berliner's

test showed that Durum Wheat gluten is dissolved in lactic acid, while Common Wheat gluten swells.

DIASTATIC POWER

This property was determined by Berliner's method (7) in 70% milled flour. Results given below indicate that the diastatic power of Durum Wheat varieties is unusually high; this might cause excessive stickiness in the bread.

	Nursi	Heity	Juljuli	Mughrabi	Giza-4	C.C.C.	B.I.P.M.	Morocco-386
mg. maltose/ 10 g. flour:	270	290	274	180	283	97	94	160

SEDIMENTATION VALUE

This property was determined according to Zeleny (11) by mixing 4 g. of flour with dilute lactic acid and reading the volume of the solid phase after 5 minutes' sedimentation. The "specific sedimentation", which is obtained by dividing the "sedimentation value" by the percentage of protein, is higher with better gluten quality. Results in Table 4 show that Common Wheat varieties are much superior in this respect to the Durums.

TABLE 4. — SEDIMENTATION VALUE IN DURUM AND COMMON WHEAT VARIETIES

Variety	Volume of sediment (cc.)	Specific sedimentation
Durum:		
Nursi	13.0	1.2
Heity	12.5	1.2
Common:		
C.C.C.	22.0	1.8
Morocco—386	18.5	1.8

BAKING TEST.

In this test, conducted according to A.A.C.C. (1) method, the volume of a loaf of bread from 100 g. of 70% milled flour was determined. The same test was also made with an addition of 0.03% "Hi-glut" (an improver) containing ammonium-persulphate and acid calcium phosphate). From Table 5 it may be seen that Common Wheat varieties tested gave a much higher bread volume than the Durum Wheat varieties.

TABLE 5. — VOLUME OF BREADS (c.c.) MADE FROM COMMON AND FROM DURUM WHEAT FLOURS

Sample	Without "Hi-glut"	With "Hi-glut"
Durum:		
Nursi	303	306
"	297	311
Heity	275	320
"	286	320
Common:		
Morocco—386	411	467
"	423	448
"	399	438
B.I.P.M.	394	422
C.C.C.	406	—

DISCUSSION AND CONCLUSIONS

In all respects save one, chemical and baking tests showed that flours of locally grown Common Wheat varieties are superior to those of the local Durum Wheat varieties for baking purposes. Common Wheats are not superior to the Durums in total protein content, nor do the proportions of various proteins vary in the two wheats. The latter finding accords with Bailey's assumption (3) that there is no correlation between the proportion of protein classes and the baking qualities of wheat flours. The findings of Fiffield et al (5) that high protein content is correlated with better baking quality is not confirmed by the results herein reported. It may be, however, that the correlation between protein content and baking quality holds true for wheats of the same variety grown under different conditions, but not for different varieties. It would seem from results of the present investigation that protein-content is not the decisive factor in determining baking quality and that the superiority of the Common Wheats in all other respects accounts for their superior baking quality.

Flour of the Durum Wheats tested produces a greenish-yellow sticky dough which, after baking, gives a loaf of low volume, lacking porosity. Harris and Sibbitt (6) using "Amber Durum" flour report similar results and found that this flour may be added to Common Wheat flour in quantities up to 20% without affecting baking results, but that more significantly lowers the quality of the bread.

Doughs made of locally grown Common Wheat varieties equalled the quality of those made of imported baking flours. Since the Common Wheats give satisfactory yields under Israel agricultural conditions, they should be grown for baking purposes in preference to the Durum Wheat varieties.

REFERENCES

1. American Association of Cereals Chemists, 1941, Cereal laboratory methods. 4th edition, Lincoln, Neb., U.S.A.
2. Association of Official Agricultural Chemists, 1945, Official and tentative methods of analysis of the Association of Official Agricultural Chemists. 6th edition, Washington, D.C.
3. Bailey, C.H., 1944, The constituents of wheat and wheat products. Reinhold Publishing Corp., New York.
4. Berliner, E., and Koopman, J., 1929, Z. ges. Muehlenwesen, 6, 57—75.
5. Fiffield, C.C., Weaver, R. and Hays, J.F., 1950, Bread loaf volume and protein content of hard red spring wheats. Cer. Chem., 27, 383.
6. Harris, R.H., and Sibbitt, L.P., 1950, Effects on baking quality of blending durum wheat flour with bread wheat flour. Bakers Digest, 24, 61—66.
7. Kent-Jones, P., and Amos, A.I., 1947, Modern Cereal Chemistry. The Northern Publication Co., Liverpool.
8. Krtynsky, 1933, Die Prüfung der Eigenschaften des Klebers. Das Mühlenlaboratorium, Juni, 1933.
9. Neuman, M.D., and Strube, J., 1933, Wert der Methode Berliner. "Züchter," 5, 54—61.
10. Pelshenke, P., 1933, Z. Züchtung, A. 18, (1). Beiträge zur Qualitätszüchtung des Weizens.
11. Zeleny, L., 1947, A simple sedimentation test for estimating the bread-baking and gluten qualities of wheat flour. Cer. Chem. 24, 465—475.